APPARATUS AND METHODS FOR PROVIDING AN EMERGENCY LIGHTING AUGMENTATION SYSTEM

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. provisional patent application Ser. No. 60/510,915, filed Oct. 14, 2003, and is a continuation-in-part of U.S. utility patent application Ser. No. 10/060,711, filed January 30, 2002. Each of the above applications are fully incorporated herein by reference.

BACKGROUND OF THE INVENTION

1) Field of the Invention

[0002] The present invention relates generally to the field of illumination and, more particularly, the invention relates to a solid state lighting source such as a light-emitting diode (LED) device that provides prolonged emergency lighting in response to a power loss event.

2) Description of Related Art

[0003] Periodically, homes, offices, public buildings, hospitals, industrial manufacturing facilities and the like, experience emergency situations which cause power failures leaving these buildings entirely without light. Such power failures may result from electrical short circuits, brownouts, fire, accidents, natural disasters (i.e., floods, hurricanes, tornados, etc.) or a planned shutdown of electricity within a facility or dwelling. Should these facilities remain without power, especially in the critical areas of these facilities (e.g., intensive care units of hospitals, exit hallways and stairwells generally, and the like) the public safety is placed at risk. Accordingly, local, state and federal authorities have required that emergency lighting systems be installed in all critical areas of public buildings.

[0004] Conventional stand-alone emergency lighting systems consist of incandescent, fluorescent or halogen lamps powered by NiCad, NiMh, Alkaline, or sealed lead battery modules. Such units are generally able to provide between 1 and 3 hours of effective emergency lighting. Unfortunately, however, most emergency-generated power outages last much longer than three hours. Further, the need for effective lighting may

not be realized until the disaster has abated. For example, after a fire or earthquake rescue crews may need to search buildings or other dwellings for injured occupants. In such cases, rescue crews are currently left to perform their search and rescue without the aid of emergency light.

[0005] Accordingly, a need exists to provide a device for automatic, high-level illumination that is capable of immediate activation in response to a disruption of power. In such emergency situations, it is desirable for the illuminating device to be efficiently powered by a single battery pack or the like, such that the device is capable of constant high-level illumination lasting for several days or even weeks. Further, the illuminating device should be easily configured to adapt to existing fluorescent, incandescent or halogen light fixtures.

BRIEF SUMMARY OF THE INVENTION

[0006] The above and other needs are met by the present invention which includes an emergency lighting device comprising, at least one light emitting diode (LED), a local energy source such as a lithium ion battery, a control circuit in electric communication with the at least one LED and further sensing a main power supply, and a reflector for broadcasting light produced by the LED to designated areas. In particular, the present invention transforms existing fluorescent, incandescent or halogen light fixtures into emergency lighting systems for homes, hospitals, hotels, nursing homes and businesses. The device includes a power sensor for triggering the control circuit to engage the LEDs when electrical service is disrupted, thereby broadcasting a wash of light over an otherwise darkened room or corridor.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0007] Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

[0008] Figure 1 depicts a perspective view of an emergency lighting device in accordance with one embodiment of the present invention;

[0009] Figure 2 illustrates a partially exploded perspective view of an emergency lighting device, in accordance with an embodiment of the present invention;

[0010] Figure 3 illustrates a schematic view of an electronic circuit board, in accordance with one aspect of the present invention;

[0011] Figure 4 illustrates a detail view of a LED unit, in accordance with another embodiment of the present invention;

[0012] Figure 5 illustrates a top view of a LED unit, in accordance with one embodiment of the present invention;

[0013] Figure 6 illustrates a perspective view of a conventional light fixture which is provided for illustration purposes. In particular, the depicted fixture is one of many lighting fixtures which are usable in conjunction with an emergency lighting device according to one embodiment of the present invention;

[0014] Figure 7 illustrates a detail view of a partially sectioned light fixture assembly as used in conjunction with one embodiment of the present invention, taken along circle 7/8 of Figure 6;

[0015] Figure 8 illustrates a detail view of a partially installed emergency lighting device in accordance with one embodiment of the present invention, taken along circle 7/8 of Figure 6;

[0016] Figure 9 illustrates a perspective view of an fully installed emergency lighting device in accordance with one embodiment of the present invention;

[0017] Figure 10 illustrates an electrical schematic drawing in accordance with one embodiment of the present invention; and

[0018] Figure 11 depicts a flow diagram of a method for implementing an emergency lighting system, responsive to disruption of a main power supply in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0019] The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete and will

fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

[0020] Figure 1 depicts a perspective view of a lighting device in accordance with one embodiment of the present invention. According to the depicted embodiment, the emergency lighting device **10** structurally comprises, a main body housing **20**, a power supply connector **30**, an array of light emitting diodes **40** (LEDs) and a LED wire **35**. In particular, electricity is channeled from the main body housing **20** to the LEDs **40** via a LED wire **35**. Although depicted as including a plurality of individual LED units **41**, the present invention may include as few as one LED unit **41**.

[0021] Within the enclosure provided by the main body housing **20**, as illustrated in Figure 2, the lighting device **10** further comprises a circuit board **21** having a control circuit (not shown), a power sensor **22** and a local energy source **25**. The local energy source **25** may include a battery pack or other similar self-contained power unit as known to one of ordinary skill in the art. In addition, a battery charger (not shown) may also be provided in those embodiments employing re-chargeable batteries. These components are provided in electrical communication via corresponding electrical circuitry.

[0022] According to the depicted embodiment, the emergency lighting device **10** is electrically connected to a main power supply (not shown) of a building via the main power supply connector **30**. Once installed, the device provides emergency light to designated areas of the building for extended periods of time upon disruption of the building's main power supply. Specifically, in emergency situations, or when the main power supply is otherwise disrupted, the power sensor **22** triggers the control circuit **23** to engage the LEDs **40**. Advantageously, the LEDs **40** efficiently draw energy from the local energy source **25** and depending upon the source used, may provide effective emergency lighting for more than 40 hours. During periods when the main power supply is functioning properly, according to one embodiment, a battery charger (not shown) may be provided to draw energy from the main power supply and thereby re-charge the battery pack or other similar local energy source **25**.

[0023] Although the control circuit **23**, local energy source **25**, and LEDs **40** are shown in Figures 1 and 2 as one integral unit, these components may optionally be mounted remote from one another. For example, according to one embodiment, a single

control circuit **23** provides a signal which engages a single remote LED **40** which is powered by a dedicated local energy source **25**. Alternatively, in another embodiment, a single control circuit **23** provides a signal which engages multiple remote LEDs **40** which may be powered by a single local energy source **25** or multiple dedicated local energy sources **25**. The signal provided by the control circuit **23** in the above circumstances may be provided by standard "hardwired" means, such as by wire or connector, or alternatively by RF or other wireless technologies as known to one of ordinary skill in the art.

[0024] Figure 3 provides a schematic illustration of a circuit board **21** in accordance with one embodiment of the present invention. According to this embodiment, the circuit board **21** supports and provides electronic communication between the power sensor **22**, electrodes **27** for contacting a local energy source **25**, and the control circuit **23**. In addition, a LED wire **35** and main power supply connector **30** are attached for providing electronic communication with the LEDs **40** and main power supply, respectively. In this regard, the main power supply connector **30** may be integral with the LED wire **35** as shown, or alternatively, may be attached to the circuit board **21** via distinct connectors (not shown). As referenced above, the power sensor **22** senses the status of the main power supply and provides input to the control circuit **23**, which selectively engages the LEDs **40** to operate in either a rest mode or a luminance mode.

[0025] Figure 4 illustrates a detail view of an individual LED unit **41** in accordance with one embodiment of the present invention. In particular, according to the depicted embodiment, the LED unit **41** comprises a LED **42**, a LED housing **44**, a LED base **46** and a mounting surface **48**. As illustrated in Figure 5, the LED housing **44** encloses the LED **42** and also supports a reflector (not shown) for directing the light emitted by the LED **42**. To accommodate proper installation, the mounting surface **48** of the LED unit **41** may be adapted to incorporate an adhesive agent, slots or grooves, mounting screws or other similar means as known to one of ordinary skill in the art. Further, electrical energy is provided to the LED unit **41** via a LED wire **35**.

[0026] Figure 5 depicts a top view of an LED unit **41**, in accordance with one embodiment of the present invention. As referenced above, an LED unit **41** is depicted having an LED **42** positioned within a reflector **43** for reflecting light in desired

directions. In one embodiment the reflector **43** may be a parabolic reflector. As a result, the geometric relationship between the LED **42** and the reflector **43** aids in dispersing the light, resulting in a lighting device **10** that is capable of broadcasting a wide-area blanket of light up appending walls or off of ceilings so as to properly illuminate a darkened room or corridor. In the embodiment shown in Figure 5, the LED **42** is directed outwardly, away from the concave surface of the reflector **43**. In another embodiment, the LED **42** may be directed inwardly (not shown), toward the concave surface of the reflector **43**. The concave surface of the reflector **43** are typically highly polished to provided the necessary degree of reflectivity. Alternatively, the concave surface of the reflector **43** may be coated with a reflective material.

[0027] As discussed above, in one embodiment, a power sensor **22** provides an on/off signal to the control circuit **23**, based upon a sensed main power supply disruption. If a main power supply disruption is present, an "off" signal is sent by the power sensor **22** to the control circuit **23**, which thereby engages the LEDs **40** to operate in a luminance mode. Accordingly, the LEDs **40** provide lighting to the darkened room or corridor. Advantageously, the LEDs **40** of the present invention consume over 90 percent less energy than standard incandescent light bulbs, thereby increasing prospective emergency lighting term from a few hours to several weeks. If no main power disruption is sensed, an "on" signal is sent by the power sensor **22** to the control circuit **23**, and the LEDs **40** remain unengaged pending further input as discussed below.

[0028] To operate effectively, the lighting device according to several embodiments of the present invention requires only 1.) electrical communication with a power supply which subject to interruption, and 2.) proper location within a building or other structure so as to be useful to occupants thereof during emergency or other power disruptions. With regard to location, the lighting device according to the present invention may be physically mounted in any location within a building, however, one area of convenient mounting is adjacent the building's existing light fixtures. Such areas provide ready access to the building's main power supply and generally already exist in areas where light is desired by building occupants. Further, as described in detail below, relatively little retro-fit is required within such fixtures to support the lighting devices of the present invention in an aesthetically pleasing manner.

[0029] Figure 6 and 7 illustrate perspective views of a conventional fluorescent light fixture. Such fixtures are commonly used in public buildings and are readily adapted for use in conjunction with several embodiments of the emergency lighting device **10** according to the present invention. Typically, fluorescent light fixtures **60** include at least one fluorescent light tube or bulb **65** and corresponding electrical circuitry (not shown) for providing electric current thereto. As illustrated in Figure 7, a ballast **75** may also be provided to control the electric current applied to the fluorescent tubes **65**. Further, a ballast cover **70** is generally provided to aesthetically hide the ballast **75** from view. Although a fluorescent light fixture is provided for illustration purposes, the inventive concepts described herein are not limited to use in such a fixture. In fact, the present invention is useful in conjunction with any light fixture or application (e.g., incandescent, halogen, neon, etc.,) which is in communication with a power supply that is subject to interruption. Further, as described above, the present invention may provide emergency lighting completely removed from any existing light structure.

[0030] Figure 8 depicts a schematic view of a lighting device in accordance with yet another embodiment of the present invention. According to the depicted embodiment, the emergency lighting device **10** attaches to a conventional ballast **75** as shown. In particular, the device **10** attaches to the power wire **76**, ground **77** and neutral wires **78** of a conventional ballast **75**. Alternatively, as referenced above, in other embodiments the device may tap directly into the main power supply without using the ballast **75**. According the embodiment described by Figure 8, the main body housing **20** (and the enclosed local energy source **25**, circuit board **21**, etc.) may be mounted within the recess **72** provided to house the ballast **75** as shown. Thus, the ballast cover **70** may re-installed to aesthetically hide both the ballast **75** and the housing **20** from view without further retrofit.

[0031] As illustrated in Figure 9, according to one embodiment of the present invention the LEDs **40** may be installed directly to the ballast cover **70**. In particular, the LED array **40** may be adhered to the surface of the cover, provided within cut-outs or recessed openings, or otherwise attached as known to one of ordinary skill in the art. Alternatively, in another embodiment the LEDs **40** may be secured to an exterior wall surrounding the fixture (not shown). In addition, in yet another embodiment, the LEDs

40 may be secured or located remotely from the unit as known to one of ordinary skill in the art. In addition, although shown in a linear configuration, the LEDs **40** according to present invention may be provided in a circular, elliptical, rectangular or other similar pattern without departing from the inventive concepts herein disclosed.

[0032] Figure 10 provides an electrical circuit diagram with regard to yet another embodiment of the present invention. According to this embodiment, the lighting device includes an electrical circuit **110**, comprising a control circuit **120** that is attached to a PC board (not shown) and structured in electrical communication with a power sensor **122**, an off-line power conversion **115**, and a LED drive circuit/boost converter **150**. The control circuit **120** registers signals provided by the power sensor **122** and further, provides the necessary logic to engage the LED drive circuit/boost converter **150**, which thereby engages the array of LEDs **30** to operate in either a rest mode or a high level luminance mode. In another embodiment, a local energy source **125** is provided in electrical communication with a battery charger **122**; the charger **122** being connected to a main power supply for powering the charger **122** and subsequently charging the local energy source **125** as needed.

[0033] Figure 11 illustrates a method for implementing an emergency lighting system having power disruption responsiveness, in accordance with one embodiment of the present invention. According to this embodiment, the method comprises the step of sensing a main power supply **200**. If the main power supply has been interrupted, a luminance LED step **210** is triggered. If the main power supply is uninterrupted, the LEDs **30** are engaged to operate in a rest mode **215**. Finally, in several embodiments of the present invention, the emergency lighting system is designed to loop so as to repeat the above-described method indefinitely upon activation.

[0034] Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms

are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.